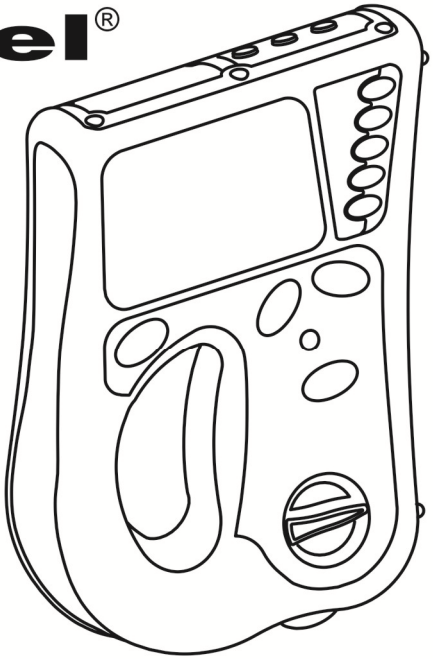
Sonel®



OPERATING MANUAL

INSULATION RESISTANCE METER

MIC-2505

MIC-2505 digital meter is designed to measure insulation resistance and voltage.

The most important features of MIC-2505 include:

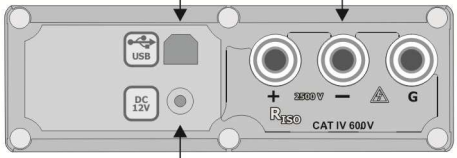
- ❑ Measurement of insulation resistance:
  - test voltages: 500V, 1000V and 2500V,
  - measurement of insulation resistance up to 2TΩ,
  - auto-ranging measurement,
  - direct measurement of one or two absorption coefficients,
  - acoustic indication of five-second intervals to facilitate capturing time parameters for insulation resistance measurements,
  - automatic discharge of the capacitance of tested object after the insulation resistance measurement is completed.

- ❑ Other:
  - automatic selection of measuring range,
  - large, readable display with backlight option,
  - monitoring of the battery charge status,
  - AUTO-OFF function,
  - ergonomic operation.

VIEW FROM THE TERMINALS

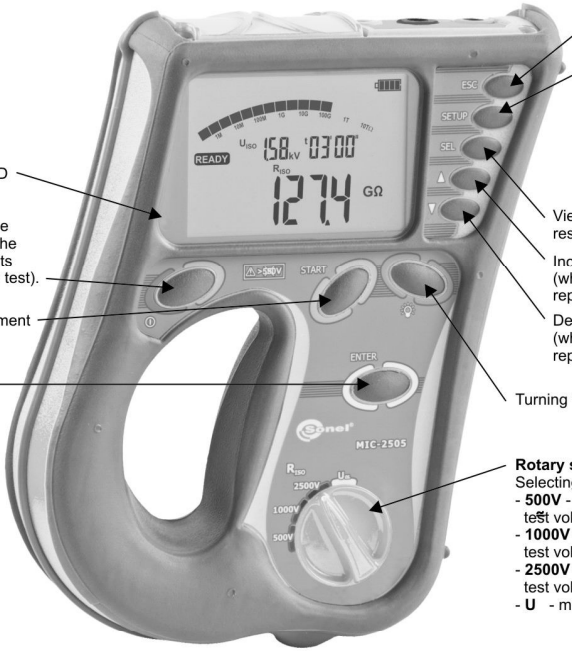
USB socket
Socket for connecting a data cable to your computer.

Measurement terminals
Sockets for connecting the test leads for measuring insulation resistance, in low-voltage resistance measurement and in testing circuit continuity.



Charger socket
Socket for connecting a charger for rechargeable batteries.

MIC-2505



LED

Power on/off. After the meter is turned ON, the display shows all digits and symbols (display test).

Starting the measurement procedure.

Approving selected option.

Exit the function.
Back to previous screen.

Selection of measurement parameters in individual functions.
After turning the meter on with the button kept depressed - selection of general measurement parameters:
- time to Auto-OFF
- rated mains frequency,
- type of absorption coefficient.

Viewing components of the measurement result, changing parameters in SETUP.

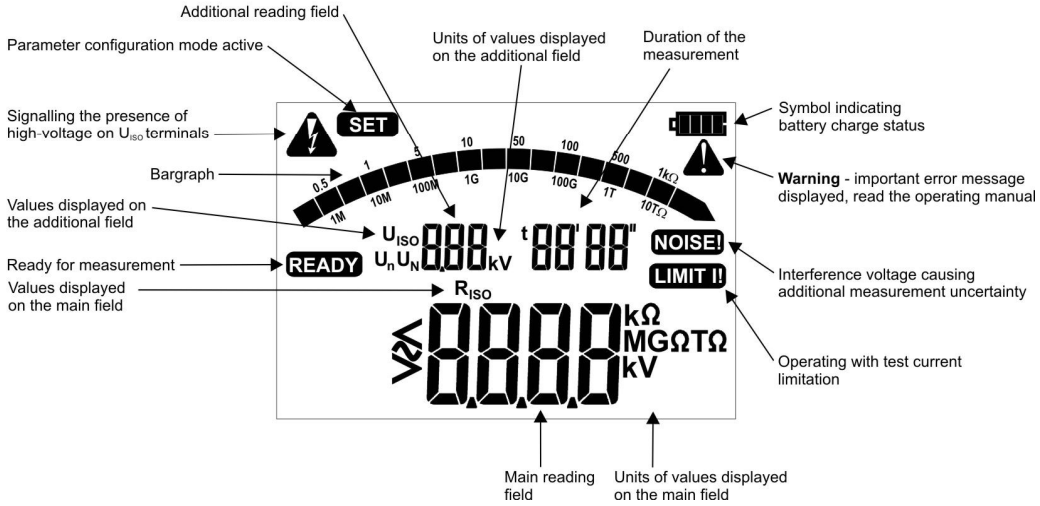
Increasing the value of chosen parameter (when depressed the action is automatically repeated).

Decreasing the value of chosen parameter (when depressed the action is automaticall repeated).

Turning the display backlight on/off.

Rotary switch of function selection
Selecting the measurement function:
- **500V** - measurement of insulation resistance using test voltage of 500V,
- **1000V** - measurement of insulation resistance using test voltage of 1000V,
- **2500V** - measurement of insulation resistance using test voltage of 2500V,
- **U** - measurement of mains voltage and frequency.

DISPLAY



OPERATING MANUAL

INSULATION RESISTANCE METER
MIC-2505

CE

SONEL SA
ul. Wokulskiego 11
58-100 Świdnica

Version 1.05 15.06.2015

MIC-2505 meter is a modern, easy in use and safe measuring device. Please acquaint yourself with the present manual in order to avoid measuring errors and prevent possible problems related to operation of the meter.

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1 Safety

MIC-2505 meter is designed for performing check tests of protection against electric shock in mains systems. The meter is used for making measurements and providing results to determine safety of electrical installations. Therefore, in order to provide conditions for correct operation and the correctness of the obtained results, the following recommendations must be observed:

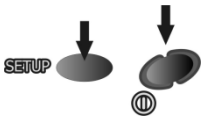
- Before you proceed to operate the meter, acquaint yourself thoroughly with the present manual and observe the safety regulations and specifications determined by the producer.
- Any application that differs from those specified in the present manual may result in a damage to the device and constitute a source of danger for the user.
- MIC-2505 meters must be operated only by appropriately qualified personnel with relevant certificates authorising the personnel to perform works on electric systems. Operating the meter by unauthorised personnel may result in damage to the device and constitute a source of danger for the user.
- During measurements of insulation resistance, dangerous voltage up to 2.5 kV occurs at the ends of test leads of the meter.
- Before the measurement of insulation resistance you must be sure that tested object is disconnected from the power supply.
- During the measurement of insulation resistance do not disconnect test leads from the tested object before the measurement is completed (see par. 3.1); otherwise the capacitance of the object will not be discharged, creating the risk of electric shock.
- Using this manual does not exclude the need to comply with occupational health and safety regulations and with other relevant fire regulations required during the performance of a particular type of work. Before starting the work with the device in special environments, e.g. potentially fire-risk/explosive environment, it is necessary to consult it with the person responsible for health and safety.
- It is unacceptable to operate the following:
  - ⇒ a damaged meter which is completely or partially out of order,
  - ⇒ a meter with damaged test leads insulation,
  - ⇒ a meter stored for an excessive period of time in disadvantageous conditions (e.g. excessive humidity). If the meter has been transferred from a cool to a warm environment with a high level of relative humidity, do not start measurements until the meter is warmed up to the ambient temperature (approximately 30 minutes).
- Displayed **BATT** symbol indicates insufficient voltage of power supply and the need to charge the accumulator or replace batteries.
- Symbols **Err*X***, where ***X*** is a number 1…9, indicate incorrect operation of the meter. If after restarting the device this situation is repeated - it indicates that the meter is damaged.
- If after switching ON and displaying software version, message dAtE is displayed and the meter switches OFF - send the meter for servicing. When dAtE is displayed every time after the meter is switched ON, but the meter enters the measurement mode – update its software.
- Before measurement, choose a correct measurement function and make sure that test leads are connected to respective measuring terminals.
- Do not operate a meter with an open or incorrectly closed battery (accumulator) compartment or power it from other sources than those specified in the present manual.
- $\mathbf{R_{ISO}}$ inputs are electronically protected against overloads (caused by e.g. connecting the meter to a live circuit) up to 600 V for 60 sec.
- Repairs may be carried out only by an authorised service point.

Note:
Due to continuous development of the meter's software, the actual appearance of the display, in case of some of the functions, may slightly differ from the display presented in this operating manual.

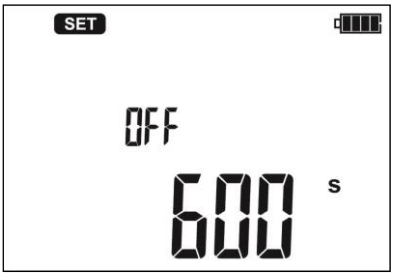
Note:
An attempt to install drivers in 64-bit Windows 8 may result in displaying "Installation failed" message.
Cause: Windows 8 by default blocks drivers without a digital signature.
Solution: Disable the driver signature enforcement in Windows.

2 Meter Configuration

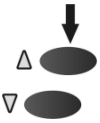
1



Turn on the meter keeping **SETUP** button pressed.



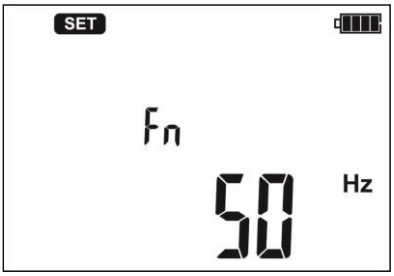
2



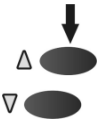
Use △ and ▽ buttons to set the auto-off time or cancel auto-off function (horizontal lines).

3

Press **SEL** button to enter the setting of nominal network frequency.

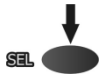


4

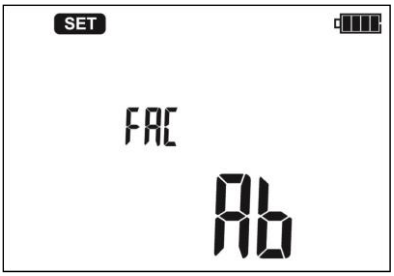


Use △ and ▽ buttons to set the frequency value.

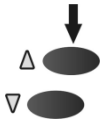
5



Press **SEL** button to enter the setting the type of absorption coefficients.

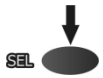


6

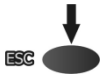


Use Δ and ∇ to set Ab1, Ab2 parameters (Ab) or PI, DAR (PI).

7



Press **ENTER** to display the measurement screen, approving introduced changes or…



…press **ESC** to go to the measurement screen without validating the changes.

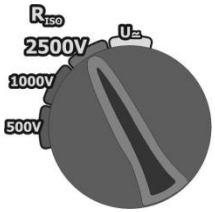
3 Measurements

3.1 Double-lead measurement of insulation resistance

WARNING:
The object tested must not be live.

Attention:
During measurement, especially of high resistances, make sure that test leads do not touch each other and the probe (crocodile clips), because such a contact may cause the flow of surface currents resulting in additional error in measurement results.

1

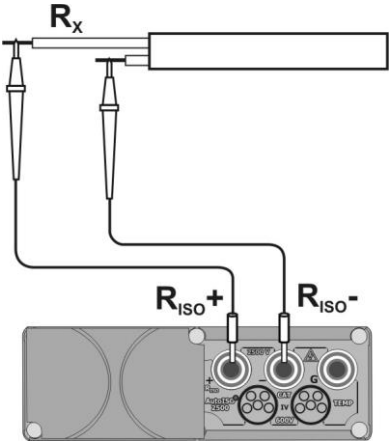


Set the rotary switch of function selection at one of $\mathbf{R_{ISO}}$, choosing measurement voltage. The meter is in the voltage measurement mode.

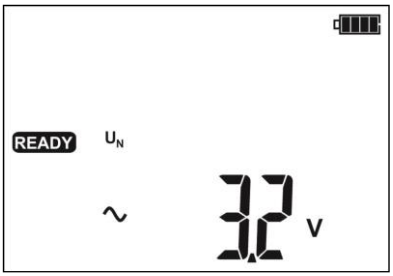
Times for calculating absorption coefficients are fixed at t_1 = 15s (30s for the coefficients Pi DAR), t_2 = 60s and t_3 = 600s.

2

Connect test leads according to the drawing.



3

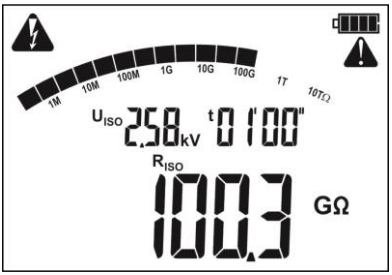


The meter is ready for measurement.

4

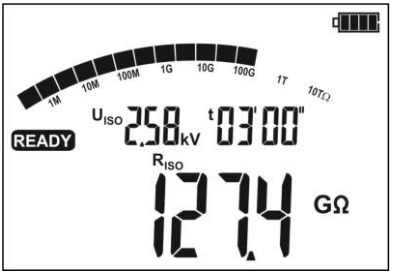
Press and hold **START** push-button. The measurement is performed continuously until you release the button or the pre-set time is reached.

In order to maintain (block) the measurement press **ENTER** while holding **START** button pressed - a triangle with an exclamation mark will be displayed indicating about automatic measurement, now the buttons may be released. In order to interrupt the measurement, press **START** or **ESC**.



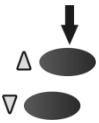
View of the screen during measurement. The triangle displayed on the right side means that the measurement was started with **ENTER** button.

5



After measuring is completed, read the result.

13



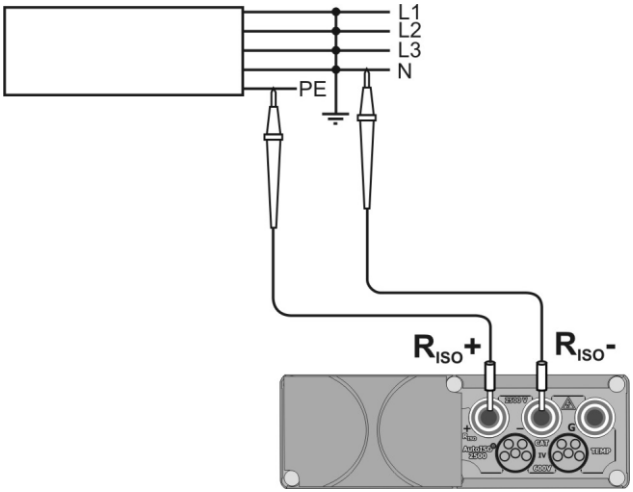
Use Δ and ∇ to see individual components of the result in the following order:
$R_{ISO} \rightarrow I_L \rightarrow Ab2 \rightarrow Ab1 \rightarrow Rt3 \rightarrow It3 \rightarrow Rt2 \rightarrow It2 \rightarrow Rt1 \rightarrow It1 \rightarrow R_{ISO}$.

Note:

During measurements of insulation resistance, dangerous voltage up to 2.5 kV occurs at the ends of test leads of MIC-2505 meter.

It is forbidden to disconnect test leads before the measurement is completed. Failure to obey the above instruction will lead to high voltage electric shock and make it impossible to discharge the tested object.

- Timer measuring the measurement time is started when U_{ISO} voltage is stabilized.
- Symbol **LIMIT** means operation with limited converter current. If this condition persists for 20 seconds the measurement is interrupted.
- If the timer reaches characteristic points (tx times), then for 1s instead U_{ISO} a symbol of this point is displayed which is accompanied by a long beep.
- During the measurement LED is lit in yellow.
- After completion of measurement, the capacitance of the tested object is discharged by shorting **R_{ISO}+** and **R_{ISO}-** terminals with resistance of 100 kΩ.
- In case of power cables measure the insulation resistance between each conductor and other conductors shorted and grounded (figure below).



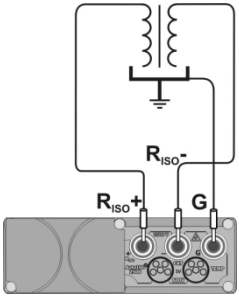
Additional information displayed by the meter

	Test voltage is present on terminals of the meter**.**
NOISE!	Interference voltage higher than 25V but lower than 50V, is present on the tested object. Measurement is possible but may be burdened with additional uncertainty.
READY disappears, LED lights red, two-tone beep	Interference voltage higher than 50V is present on the tested object. The measurement is blocked.
LIMIT I!	Activation of current limit. The symbol displayed is accompanied by a continuous beep.
ErrHiLE	Breakdown of the tested object insulation, the measurement is interrupted. The message appears after displaying **LIMIT I!** for 20s during the measurement, when voltage previously reached the nominal value.
ErrUdEt LED is lit in red, two-tone acoustic signal	During the measurement, AC voltage appeared or the object cannot be discharged for 30 seconds. After 5 seconds the meter returns to its default state - voltmeter.

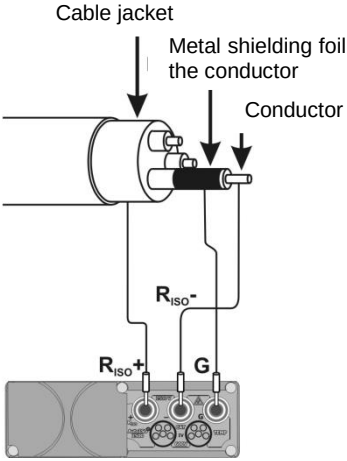
3.2 Three-lead measurement of insulation resistance

In order to eliminate the influence of surface resistance in transformers, cables, etc. a three-lead measurement is used. For example:

- at the measurement of inter-winding resistance of a transformer, **G** socket of the meter should be connected to the transformer tank;



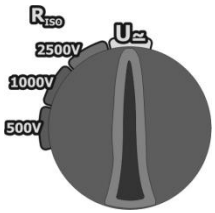
- when measuring insulation resistance between one of the cable conductors and the cable jacket, the effect of surface resistances (important in difficult weather conditions) is eliminated by connecting a piece of metal foil wounded around the insulation of the tested conductor with **G** socket of the meter;



The same shall apply when measuring the resistance between two conductors of the cable, attaching to **G** terminal other conductors that do not take part in the measurement.

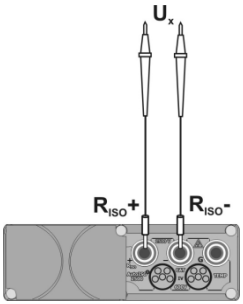
3.3 Voltage measurement

1



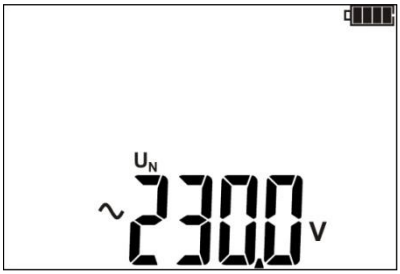
Set the rotary switch of function selection at **U** ∿ position.

2



Connect the meter to a voltage source.

3



Measurement is performed in a continuous manner.

Additional information displayed by the meter

> 600 V, LED is lit in red, two-tone acoustic signal	Voltage is higher than acceptable. **Immediately** disconnect the test leads.

4 Software updates

Turn on the meter, holding **ENTER** and **SETUP** buttons depressed.

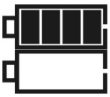
The meter displays the following screen.

After connecting the meter to a PC using a USB cable, follow the instructions of the software.

5 Meter power supply

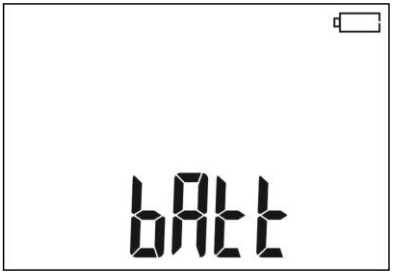
5.1 Monitoring of the power supply voltage

The charge level of rechargeable batteries is indicated by the symbol in the right upper corner of the display on a current basis:



Batteries charged.

Batteries low. Only voltage measurement is available.



Batteries fully discharged, all measurements are blocked. The meter switches off automatically after 5 sec.

5.2 Replacing rechargeable batteries

MIC-2505 meter is powered from SONEL NiMH 9.6 V battery pack, including NiMH rechargeable batteries.

Battery charger is installed inside the meter and cooperates only with the manufacturer's battery pack. The charger is powered by external power supply adapter. It can be also powered from the car cigarette lighter socket, using an optional charger.

WARNING:
If the test leads are left in the terminals during replacement of the batteries, there is a risk of electric shock with a dangerous voltage.

To replace the rechargeable batteries:
1. Disconnect the leads from the measuring circuit and turn off the meter,
2. Unscrew the 3 screws and remove the battery compartment (in the bottom of the enclosure).
3. Insert and bolt the battery compartment containing a new battery pack.

NOTE!
Do not power the meter from sources other than those listed in this manual.

5.3 Charging rechargeable batteries

Charging commences once the power supply has been connected to the meter regardless of the fact whether the meter is on or off. Charging is indicated by changing status of battery charge. The rechargeable batteries are charged in accordance with the algorithm of „quick charge" – this process permits to reduce the duration of charging to approximately three hours. Completed charging process is indicated by full battery charge status and beep. In order to turn the device off, remove the power supply plug of the charger.

Note:

- As a result of interferences in the network it is possible that the process of charging of accumulators will finish too fast. When charging time is too short, turn off the meter and start charging again.

Additional information displayed by the meter

Signalling	Cause	Proceeding
Battery symbol appears as un-filled.	Temperature of the battery pack is too high!	Wait until the battery pack is cool. Start charging process again.
The symbol of unfilled battery flashes.	Emergency	Try to start the charging process again. If this does not help, it is possible that battery pack is damaged - replace it.
The symbol of full battery flashes.	An attempt of recharge fully charged battery pack was detected.	

5.4 General principles regarding using NiMH rechargeable batteries

- If you do not use the device for a prolonged period of time, then it is recommended to remove the rechargeable batteries and store them separately.

- Store the rechargeable batteries in a dry, cool and well ventilated place and protect them from direct sunlight. The temperature of the environment in the case of prolonged storage should not exceed 30°C. If the rechargeable batteries are stored for a long time in a high temperature, then the occurring chemical processes may reduce their lifetime.

- NiMH batteries withstand normally 500-1000 charging cycles. These batteries reach their maximum capacity after being formatted (2-3 charge/discharge cycles). The most important factor which influences the lifetime of rechargeable batteries is the level of their discharge. The deeper the discharge level of the batteries, the shorter their lifetime.

- The memory effect is limited in case of NiMH batteries. These batteries may be charged at any point with no serious consequences. However, it is recommended to discharge them completely every few cycles.

During storage of NiMH batteries they are self-discharged at the rate of approximately 30% per month. Keeping rechargeable batteries at high temperatures may accelerate this process even 100%. In order to prevent excessive discharge of rechargeable batteries, after which it would be necessary to format them, it is recommended to charge them from time to time (even if they are not used).

- Modern fast chargers detect both too low and too high a temperature of rechargeable batteries and react to the situation adequately. Too low temperature should prevent starting the process of charging, which might irreparably damage rechargeable batteries. An increase of the temperature of the rechargeable batteries is a signal to stop charging and is a typical phenomenon. However charging at a high ambient temperature apart from reducing batteries' lifetime causes an accelerated increase of their temperature and the result is that the batteries are not charged to their full capacity.

- Please note that when the batteries are charged with a fast-charger they are charged only to approx. 80% of their capacity - better results can be achieved by continuing charging: the charger enters trickle-charging mode and during the next few hours batteries are charged to their full capacity.

- Do not charge or use rechargeable batteries in extreme temperatures. Extreme temperatures reduce the lifetime of batteries and rechargeable batteries . Avoid placing devices powered by rechargeable batteries in very hot environments. The nominal working temperature must be absolutely observed.

6 Cleaning and maintenance

NOTE!
Apply solely the maintenance methods specified by the manufacturer in this manual**.**

The casing of the meter may be cleaned with a soft, damp cloth using all-purpose detergents. Do not use any solvents or cleaning agents which might scratch the casing (powders, pastes, etc.).

The electronic system of the meter does not require maintenance.

7 Storage

In the case of storage of the device, the following recommendations must be observed:

- Disconnect all the test leads from the meter.

- Clean the meter and all its accessories thoroughly.
- In the case the meter is to be stored for a prolonged period of time, batteries/rechargeable batteries must be removed from the device.
- In order to prevent a total discharge of the rechargeable batteries in the case of a prolonged storage, charge them from time to time.

8 Dismantling and Disposal

Used electrical and electronic equipment should be collected selectively, i.e. it must not be placed with another kinds of waste.

Used electronic equipment should be sent to a collection point in accordance with the Used Electrical and Electronic Equipment Act.

Before the equipment is sent to a collection point, do not dismantle any elements.

Observe the local regulations concerning disposal of packages and used batteries/rechargeable batteries.

9 Technical specifications

9.1 Basic data

⇒ Abbreviation "m.v" used in the specification of measurement uncertainty means a standard measured value

AC / DC voltage measurement

Display range	Resolution	Basic uncertainty
0…600V	1 V	±(3% m.v. + 2 digits)

- Frequency range: 45...65Hz

Measurement of insulation resistance

Measuring range according to IEC 61557-2: $R_{ISOmin} = U_{ISOnom}/I_{ISOnom}$ …2,000TΩ (I_{ISOnom} = 1mA)

Double-lead measurement

Display range	Resolution	Basic uncertainty
0.0 ... 999.9 kΩ	0.1 k Ω	±(3 % m.v. + 20 digits)
1.000 ... 9.999 MΩ	0.001MΩ	
10.00...99.99MΩ	0.01 MΩ	
100.0 ... 999.9 MΩ	0.1 MΩ	
1.000 ... 9.999 GΩ	0.001 GΩ	
10.00 ... 99.99 GΩ	0.01 GΩ	
100.0...999.9GΩ	0.1 GΩ	
1.000...2.000TΩ	0.001TΩ	

Approximate maximum values of the measured resistance, depending on the test voltage, are presented in the table below. For other voltages the range limits may be read from the chart below.

Voltage	Test range
500V	500GΩ
1000V	1,00TΩ
2500V	2,00TΩ

⇒ **Note:** For insulation resistance below R_{ISOmin} there is no accuracy specified because the meter works with the adjustable current limit in accordance with the following formula

$$R_{ISO\,\min} = \frac{U_{ISOnom}}{I_{ISOnom}}$$

where:

R_{ISOmin} - minimum insulation resistance measured without limiting the converter current
U_{ISOnom} - nominal test voltage
I_{ISOnom} - nominal inverter current (1mA)

Other technical specifications

a) type of insulation.....double, EN 61010-1 and IEC 61557 compliant
b) measurement category ..... IV 600V (III 1000V) according to EN 61010-1
c) degree of housing protection acc. to EN 60529.....IP54
d) power supply of the meter..... SONEL L-1 battery pack 9.6 V, NiMH
e) parameters of AC adapter for the battery charge ..... 100 V…240 V, 50 Hz…60 Hz
f) dimensions ..... 260 x 190 x 60 mm
g) meter weight.....approximately 1.3 kg
h) storage temperature ..... –20...+70°C
i) working temperature..... -10...+40°C
j) temperature range suitable for initiating battery charging..... +10°C to +40°C
k) temperatures at which loading is interrupted.....below +5°C and above (or equal to) +50°C
l) nominal temperature..... +23 ± 2°C
m) number of R_{ISO} measurements ..... approximately 900
n) display.....LCD segment
o) quality standard .....development, design and manufacturing are ISO 9001 compliant
p) the device meets the requirements of IEC 61557 standard
q) the product meets EMC requirements (immunity for industrial environment) according to the following standards..... EN 61326-1:2006 and EN 61326-2-2:2006

9.2 Additional data according to IEC 61557-2 (R_{ISO})

Data on additional uncertainties are useful mainly when the meter is used in non-standard conditions and for metrological laboratories for the purpose of calibration.

Significant parameter	Designation	Additional uncertainty
Position	E_1	0%
Supply voltage	E_2	0% (**BAT** is not lit)
Temperature 0...35°C	E_3	0.1%/ºC

10 Equipment

10.1 Standard equipment

Standard set of equipment supplied by the manufacturer includes:

- mater MIC-2505 – **WMPLMIC2505**
- set of test leads:
  - 5kV leads, 1.8m, cat. IV 1000V terminated with banana plugs - 2 pcs. (red – **WAPRZ1X8REBB** and blue – **WAPRZ1X8BUBB**)
  - 5kV shielded lead, 1.8m, cat. IV 1000V, terminated with banana plugs - (black – **WAPRZ1X8BLBB**
- 5kV crocodile clip, cat. IV 1000V – 2 pcs. (Black – **WAKROBL32K07** and blue – **WAKROBU32K07**)

- blade probe with banana socket – 1 pcs. (red – **WASONREOGB2**)
- battery pack – **WAAKU10**
- adapter for battery pack charging – **WAZASZ7**
- CD SONEL
- meter harness – **WAPOZSZE2**
- carrying case L-4 – **WAFUTL4**
- operating manual
- calibration certificate

10.2 Optional accessories

Additionally, the following items that are not included in the scope of standard equipment can be purchased from the manufacturer or the distributors:

WAKRORE32K07

- 5kV crocodile clip, cat. IV 1000V red

WAPRZ005BLBBE5K

- 5m shielded lead, black, cat. IV 1000V

WAPRZ005REBB5K

- 5kV lead, 5m, red, with banana plugs

WAPRZ005BUBB5K

- 5kV lead, 5m, blue terminated with banana plugs

WAPRZLAD12SAM

- Cable for charging the accumulator package from the car cigarette lighter socket (12V)

WASONBLOGB2

- blade probe with banana socket black

WAPRZ010BLBBE5K

- 10m shielded lead, black, cat. IV 1000V

WAPRZ010REBB5K

- 5kV lead, 10 m, red, with banana plugs

WAPRZ010BUBB5K

- 5kV lead, 10m, blue terminated with banana plugs

WAPRZUSB

- USB interface cable

LSWPLMIC2510

- calibration certificate

11 Manufacturer

The manufacturer of the device and provider of warranty and post-warranty service:

SONEL S.A.
ul. Wokulskiego 11
58-100 Świdnica
Poland
tel. +48 74 858 38 60
fax +64 74 858 38 09
E-mail: export@sonel.pl
Web page: www.sonel.pl

NOTE
Service repairs must be performed solely by the manufacturer.

MPI-525
Multifunction Electrical Installations Meter

MPI-505
Multifunction Electrical Installations Meter

MPI-502
Multifunction Electrical Installations Meter

MRU-200
Earth Resistance and Resistivity Meter

MRU-20
Earth Resistance and Resistivity Meter

MIC-2510
Insulation Resistance Meter

MIC-2
Insulation Resistance Meter

KT-384
Thermal imager

MIC-30
Insulation Resistance Meter

PQM-701
Power quality analyzer

LXP-1
Datalogging Light Meter

PAT-805
Portable appliance tester

CMM-40
Industrial multimeter

CMP-1006
Digital Clamp-on multimeter

MMR-630
Microohmeters

CMP-200
Digital Clamp-on AC

DIT-500
IR thermometer

LKZ-700
Wire tracer

WARNINGS AND GENERAL INFORMATIONS DIPLAYED BY THE METER

NOTE!

Connecting voltage higher than 600V, between any of the test terminals may damage the meter and cause a hazard to the user.

	Test voltage is present on terminals of the meter.
	You must consult the manual.
READY	The meter is ready for measurement.
NOISE!	This inscription displayed after the measurement indicates noise in the system during the measurement The measurement result may be affected by additional uncertainty.
READY disappears, LED lights red, two-tone beep.	Interference voltage higher than 50V, is present on the tested object. The measurement is blocked.
LIMIT I!	Activation of current limit. The symbol displayed is accompanied by a continuous beep.
Err HiLE	Breakdown of the tested object insulation, the measurement is interrupted. The message appears after displaying **LIMIT I!** for 20s during the measurement, when voltage previously reached the nominal value.
Err UdEt, LED lights red, two-tone beep.	During the measurement, AC voltage appeared or the object cannot be discharged for 30 seconds. After 5 seconds the meter returns to its default state - voltmeter.
Err	Internal error.
AUTO-ZERO	Resistance compensation completed for test leads.
 bAtt	Status of rechargeable batteries: Batteries charged Batteries discharged Batteries fully discharged. Recharge or replace battery pack.

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